A marked-up copy of the amended abstract and claims is appended hereto, with additions underlined and deletions in brackets.

I. Restriction Requirement

Applicant disagrees with the restriction requirement, but acknowledges that the Examiner has made the restriction requirement final.

II. Abstract

The abstract was objected to for exceeding 250 words and 25 lines.

A new abstract is provided herein. Withdrawal of the objection is respectfully requested.

III. Drawing Objections

The drawings in this application were objected to as informal. Formal drawings were enclosed with the application upon filing. Apparently, the PTO has mislaid these formal drawings. Therefore, replacement copies of these formal drawings are enclosed. Withdrawal of the objection is respectfully requested.

IV. <u>Claim Objections</u>

Claims 1, 2, 5, 8, 9, and 12 were objected to for alleged informalities for reciting subject matter drawn to non-elected claims.

Claim 1 was amended to omit "producing through chromosome doubling." The objection is thus obviated, and withdrawal thereof is respectfully requested.

Claim 2 was amended to omit "greater pollen fertility." Thus, the objection is obviated, and withdrawal of the objection is respectfully requested.

Claim 5 was amended to omit "or through genetic engineering procedures using transgenic constructs;" "or transforming;" "except in the optional case of an inducible down regulation of a transgenic promoter/gene construct, which gene construct causes meiotic abortion when expressed, such that facultative apomixis is expressed;" and "except during an inducible up regulation of a transgenic promoter/gene construct, that when expressed causes meiotic abortion resulting in essentially 100% apomictic seed formation." Thus, the objection is obviated, and withdrawal of the objection is respectfully requested.

Since claims 8, 9, and 12 are product-by-process claims that incorporate claims 1, 2, and 5, respectively, by reference, the objections to claims 8, 9, and 12 are also obviated. Withdrawal of the objections to these claims is also respectfully requested.

V. Rejections Under 35 U.S.C. § 112, Second Paragraph

Claims 1, 2, 5, 8, 9, and 12 were rejected under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite for failing to particularly point out and distinctly claim the subject matter that Applicant regards as the invention.

The second paragraph of 35 U.S.C. § 112 is directed to requirements for the claims:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

There are two separate requirements set forth in this paragraph: (1) the claims must set forth the subject matter that the applicants regard as their invention; and (2) the claims must particularly point out and distinctly define the metes and bounds of the subject matter that will be protected by the patent grant. MPEP § 2171.

With respect to the second of these requirements:

> The examiner's focus during examination of claims for compliance with the requirement for definiteness . . . is whether the claim meets the threshold requirements of clarity and precision, not whether more suitable language or modes of expression are available. . . . [The examiner] should allow claims which define the patentable subject matter with a <u>reasonable</u> degree of particularity and distinctness. . . . The essential inquiry pertaining to this requirement is whether the claims set out and circumscribe a particular subject matter with a reasonable degree of clarity and particularity. Definiteness of claim language must be analyzed, not in a vacuum, but in light of (1) the content of the particular application disclosure, (2) the teachings of the prior art, and (3) the claim interpretation that

> would be given by one possessing the ordinary level of skill in the pertinent art at the time the invention was made. If the scope of the invention sought to be patented cannot be determined from the language of the claims with a reasonable degree of certainty, a rejection of the claims under 35 U.S.C. 112, second paragraph is appropriate. *In re Wiggins*, 488 F.2d 538, 179 USPQ 421 (CCPA 1973).

MPEP § 2173.02 (emphasis in original); *In re Moore*, 169 U.S.P.Q. 236, 238 (C.C.P.A. 1971); *Hybritech Inc. v. Monoclonal Antibodies, Inc.*, 231 U.S.P.Q. 81, 94 (Fed. Cir. 1986); *Shatterproof Glass Corp. v. Libbey Owens Ford Co.*, 225 U.S.P.Q. 634, 641 (Fed. Cir. 1985). Further, breadth of a claim is not to be equated with indefiniteness. *In re Miller*, 441 F.2d 689, 169 U.S.P.Q. 597 (C.C.P.A. 1971). For example, if a claim is too broad because it is not supported by the original description or an enabling disclosure, then a rejection under 35 U.S.C. § 112, first paragraph, is appropriate. Moreover, it has long been recognized that there is nothing inherently wrong with using functional language in drafting patent claims. The practical necessity of using functional language in certain circumstances has been recognized by the courts. *In re Swinehart*, 439 F.2d 210, 169 U.S.P.Q. 226, 228 (C.C.P.A. 1971) (citing *In re Halleck*, 421 F.2d 911, 164 U.S.P.Q. 647 (C.C.P.A. 1970). "A functional limitation must be evaluated and considered, just like any other limitation of the claim, for what it fairly conveys to a person of ordinary skill in the pertinent art in the context in which it is used." MPEP § 2173.05(g).

With that background in mind, the rejection of claims under 35 U.S.C. § 112, second paragraph, will now be discussed.

Applicant notes that a recurring error made by the Examiner throughout the Office Action was a failure to recognize that "stabilizing" and "genetic instability" are defined terms in this application. It is axiomatic that an applicant for a patent may be his or her own lexicographer. *Markman v. Westview Instruments, Inc.*, 34 USPQ2d 1321, 1330 (Fed. Cir. 1995) (in banc), *aff'd*, 517 U.S. 370, 38 USPQ2d 1461 (1996). Within recognized limitations, this means that an applicant for a patent can define terms as he or she pleases. "Genetic instability" of an apomictic plant is defined herein, at page 12, lines 7-9, to mean that the average frequency of sexual seed formation among sexually produced progeny of such plant exceeds the average frequency of sexual seed formation of such plant. "Stabilizing" a facultatively apomictic plant exhibiting genetic instability means assuring that the average frequency of sexual seed formation among sexually derived progeny of such plant does not exceed the average frequency of sexual seed formation of such apomictic plant. Page 12, lines 10-13. The meaning of "stabilizing" is further described at page 1, lines 5-11, wherein it is stated that stabilizing an apomictic plant assures that sexually derived progeny of the apomictic plant tend to be apomictic like the mother plant, though otherwise genetically recombined, instead of being sexual revertants. In

other words, stabilizing apomictic plants results in essentially the same frequency of apomixis from one generation of sexually produced progeny of a facultatively apomictic plant to the next, instead of a greater average frequency of sexual seed formation from one generation to the next.

With these basic definitions in mind, the allegations of omitting essential steps and of using narrative, vague, and indefinite language that is not art-accepted or defined in the specification will be addressed.

Claim 1 was rejected for allegedly omitting "an essential step of a characterization of the trait of genetically stabilizing of apomixis." The Examiner treats "genetically stabilizing of apomixis" here and elsewhere in the Office Action as a "trait" not as the "process" for which Applicant is seeking a patent. Applicant respectfully submits that a person skilled in the art would recognize that genetically stabilizing apomixis is not a trait, but is the result obtained by carrying out the claimed method. Given what was already known in the art at the time the invention was made and what is disclosed in the present application, a person skilled in the art would recognize that genetic instability of apomixis is observed by the following steps.

1. Producing progeny from the suspect apomict by selfing or crossing.

2. Identifying through progeny tests, which involve standard

morphological or molecular markers, those progeny that were produced sexually (first generation of sexually-produced progeny). This includes assaying all progeny to determine if they contain the same markers as the mother plant. Differences will arise in sexually produced progeny because of genetic segregation (in the case of self pollination of the apomict) or through the inheritance of unique markers from a father (in the case of cross pollination of the apomict).

3. Calculating the frequency of sexual progeny produced relative to total progeny produced.

4. Growing the first generation of sexually produced progeny and repeating steps 2 and 3 for each.

5. Comparing the frequency of second generation sexual progeny to the frequency of first generation sexual progeny. If frequencies for second generation sexual progeny are higher than that for the first generation, then the mother apomict in question is genetically unstable.

A person skilled in the art would recognize that these steps are implicit in determining that genetic instability of apomixis exists in a plant. The presently claimed method starts after such genetic instability has been observed, and provides a process for genetically stabilizing this instability. In other words, observing genetic instability of apomixis is a precursor to the presently claimed method and is not a part of the method of

stabilizing genetic instability of apomixis *per se*.

Claim 1 was further rejected as vague and indefinite for reciting "fortuitous recombinations." Claim 1 does not and never did contain this term. Withdrawal of the rejection is thus respectfully requested.

Claim 1 was also rejected as vague and confusing for reciting "duplicate genes responsible for apomixis are isolated from each other on opposite homeologous chromosomes." After reading the instant specification, it is apparent that the present application is based on the duplicate-gene asynchrony theory, also referred to as hybridization-derived floral asynchrony (HFA) theory, which is described extensively. At page 12, line 20, through page 14, line 3, for example, it is described how in the absence of structural or karyotypic heterozygosity, genetic instability of apomixis is observed. By the same token, in the presence of structural heterozygosity, apomixis is stabilized. Genetic instability is prevented by structural (karyotypic) heterozygosity, which includes allopolyploidy, segmental allopolyploidy, inversions or translocations, sexual sterility, or paleopolyploidy. Page 13, lines 1-4. Further, induction of triploidy or other odd polyploid levels stabilizes apomixis. Page 13, lines 5-14. Allopolyploidy is the most convenient mechanism for restricting recombination. Page 13, lines 15-17. Further, in allopolyploidy, recombination generally occurs within genomes, not between genomes. Page 13,

lines 17-18. Thus, genes responsible for apomixis are maintained in a homozygous condition within genomes but a heterozygous condition between genomes. Page 13, lines 18-21. A person of skill in the art would understand from this description that producing a polyploid line from an unstable apomict would stabilize apomixis in the polyploid derivative line. It is respectfully submitted that the claims, when read in light of the specification by a person skilled in the art, describe the metes and bounds of the invention with a reasonable degree of precision and particularity. Thus, it is respectfully submitted that claim 1 is in compliance with the requirements of Section 112, second paragraph. Withdrawal of the rejection is respectfully requested.

Claim 1 was further rejected as vague and indefinite for reciting "B_{III} hybridization." This phrase has been omitted. Thus, the rejection is moot, and withdrawal is respectfully requested.

Claim 2 was also rejected for allegedly lacking an essential step. Applicant respectfully refers the Examiner to the paragraph above relating to the same issue concerning claim 1. Observing genetic instability for apomixis is a precursor to the process of genetically stabilizing apomixis and is not an essential step of the method as claimed.

Claim 2 was also rejected for allegedly omitting an essential element that the plant made by the method is an allopolyploid. It is obvious to a person skilled in the art that a polyploid with

duplicate genes responsible for apomixis isolated from each other by segmental allopolyploidy is an allopolyploid. It is also obvious to a person skilled in the art that increasing fertility of the polyploid derivative line by selfing or hybridizing with a similar plant to obtain sexually derived progeny that express unreduced egg fertility or parthenogenesis comprise a trait of greater unreduced egg fertility or parthenogenic form of reproduction. Withdrawal of the rejection is respectfully requested.

Claim 2 was further rejected for reciting "B_{III} hybridization." This term has been omitted. Thus, the ground of rejection is moot, and withdrawal is respectfully requested.

Claim 2 was further rejected for reciting "similar plant." It would be clear to a person skilled in the art that if apomixis fertility is to be increased by selfing or hybridizing with a similar plant, that the similar plant would usually be a member of the same species or genus. Withdrawal of the rejection is respectfully requested.

Claim 2 was also rejected as vague and indefinite for reciting "segmental allopolyploidy." Segmental allopolyploidy is a well understood term used by those skilled in the art of plant cytogenetics and breeding. As defined by J. Schulz-Shaeffer, Cytogenetics 252-253 (Springer-Verlag, NY 1980), segmental allopolyploids are characterized by homeology or partial homology,

which means that only some of the members of the chromosome set are homologous with those of the other set or sets, while the others are nonhomologous or only partially homologous. According to Schulz-Shaeffer, "[t]his kind of polyploidy includes a wide array of types that ranges all the way from nearly autoploid to the other extreme, almost alloploid." In view of the fact that "segmental allopolyploidy" is a standard term in the fields of plant cytogenetics and plant breeding, it is respectfully submitted that a person skilled in the art would understand the meaning of the term and that the term defines the subject matter of the claim with a <u>reasonable</u> degree of particularity and distinctness.

Claim 5 was rejected for reciting "genetically enhancing." Claim 5 is drawn to a method for genetically improving plants. A person skilled in the art would recognize that genetically enhancing the apomictic plant means improving the plant with respect to whatever quality or qualities are being selected for.

Claim 5 was further rejected for reciting "genetically stabilizing it." Again, the Examiner has failed to recognize that genetically "stabilizing" is a defined term, which is consistently used throughout the application. As a defined term, a person skilled in the art would understand what the term means and would understand the metes and bounds of the claim. Withdrawal of this ground of rejection is respectfully requested.

In view of the explanations, arguments, and amendments

described above, it is respectfully submitted that claims 1, 2, and 5 are in full compliance with the requirements of 35 U.S.C. § 112, second paragraph. Withdrawal of grounds of rejection under this section is respectfully requested.

VI. Rejections Under 35 U.S.C. § 112, First Paragraph

Claims 1, 2, 5, 8, 9, and 12 were rejected under 35 U.S.C. § 112, first paragraph, as allegedly containing subject matter that was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

"The test of enablement is whether one reasonably skilled in the art could make or use the invention from the disclosures in the patent coupled with information known in the art without undue experimentation." *United States v. Telectronics, Inc.*, 857 F.2d 778, 785, 8 USPQ2d 1217, 1223 (Fed. Cir. 1988). See also, *In re Wands*, 858 F.2d 731, 737, 8 USPQ2d 1400, 1404 (Fed. Cir. 1988). However, a patent need not teach, and preferably omits, what is well known in the art. *Hybritech Inc. v. Monoclonal Antibodies, Inc.*, 231 U.S.P.Q. 81, 94 (Fed. Cir. 1986). Determining enablement is a question of law based on underlying factual findings. *In re Vaeck*, 20 U.S.P.Q.2d 1438, 1444 (Fed. Cir. 1991); *Atlas Powder Co. v. E.I. du Pont de Menours & Co.*, 750 F.2d 1569, 1576, 224 USPQ 409, 413 (Fed. Cir. 1984).

The fact that experimentation may be complex does not necessarily make it undue if such experimentation is typical in the art. *In re Certain Limited-Charge Cell Culture Microcarriers*, 221 USPQ 1165, 1174 (Int'l Trade Comm'n 1983), *aff'd sub nom.*, *Massachusetts Institute of Technology v. A.B. Fortia*, 774 F.2d 1104, 227 USPQ 428 (Fed. Cir. 1985); *In re Wands*, 858 F.2d at 737, 8 USPQ2d at 1404. The test of enablement is not whether any experimentation is necessary, but whether, if experimentation is necessary, it is undue. *In re Angstadt*, 537 F.2d 498, 504, 190 USPQ 214, 219 (CCPA 1976).

There are many factors to be considered when making a determination whether or not a disclosure satisfies the enablement requirement and whether or not any necessary experimentation is undue, among which are: (A) the breadth of the claims; (B) the nature of the invention; (C) the state of the prior art; (D) the level of one of ordinary skill in the art; (E) the level of predictability in the art; (F) the amount of direction provided by the inventor; (G) the existence or absence of working examples; and (H) the quantity of experimentation needed to make or use the invention based on the content of the disclosure. *In re Wands*, 858 F.2d 731, 737, 8 USPQ2d 1400, 1404 (Fed. Cir. 1988) (reversing the PTO's determination that claims directed to methods for detection of hepatitis B surface antigens did not satisfy the enablement requirement).

It is improper to conclude that a disclosure is not enabling based on an analysis of only one of the above factors while ignoring one or more of the others. MPEP § 2164.01(a). The analysis must consider all of the evidence related to each of these factors, and any conclusion of nonenablement must be based on the evidence as a whole. 858 F.2d at 737, 740, 8 USPQ2d at 1404, 1407.

A. Breadth of the Claims

This invention relates to methods for stabilizing and controlling apomixis. Stabilizing apomixis refers to manipulating apomictic plants such that sexually derived progeny, which are occasionally produced facultatively from apomictic plants, tend to be apomictic like the mother plant, though otherwise genetically recombined, instead of being sexual revertants. Page 1, lines 5-11. Stated another way, producing a genetically stabilized facultative apomictic mother plant means assuring that the average frequency of sexual seed formation among sexually derived progeny of the produced facultative apomictic mother plant does not exceed that of such mother plant. Page 12, lines 10-13. Controlling apomixis refers to processes that modify in an apomict the frequency in which seed are produced sexually as opposed to asexually (apomictically). Preventing sexual seed formation completely, i.e. converting a facultative apomict to an obligate apomict, is a form of control that also represents a unique form of

genetic stabilization in that an obligate apomict cannot produce progeny sexually and hence cannot produce sexual segregants. Hence, conferring obligate apomixis (elimination of sexual seed formation) is a special form of genetic stabilization that can be used when interspecific hybridization is not desirable. Page 8, lines 3-7. Controlling apomixis also includes conferring obligate apomixis except when the plant is induced to be facultatively apomictic, or permitting facultative apomixis to occur except when the plant is induced to be obligately apomictic. Page 1, lines 11-16. The technologies described herein to accomplish stabilization and control are pioneering technologies, and, as such, these technologies are broadly claimed.

It has been consistently held that merely pointing out breadth in claim terminology is not sufficient to sustain an allegation of lack of enablement and that a party asserting lack of compliance with 35 U.S.C. § 112, first paragraph, has the burden of presenting cogent technical reasoning or objective evidence to support its position regarding enablement. *Horton v. Stevens*, 7 USPQ 1245 (Bd. App. & Int. 1988).

Moreover, claims of various scopes are present in the application. Applicant is seeking broad patent protection on the presently claimed invention. However, claims of narrow and intermediate scope are also present in the application.

B. Nature of the Invention

This application relates to stabilizing and controlling apomixis. Stabilizing apomixis means assuring that the average frequency of sexual seed formation among sexually derived progeny of an apomictic mother plant does not exceed that of such apomictic mother plant, and it includes the special case in which a facultative apomict is converted to an obligate apomict, which does not (or only rarely) reproduce sexually. Page 12, lines 10-13; page 1, lines 5-11; page 8, lines 3-7. Controlling apomixis refers to assuring that apomicts express obligate apomixis, or obligate apomixis except when induced to be facultatively apomictic, or facultative apomixis except when induced to be obligately apomictic. Page 1, lines 11-16. The elected claims relate to genetically stabilizing an apomictic plant exhibiting genetic instability for apomixis by producing a polyploid derivative line such that duplicate genes responsible for apomixis are isolated on opposite homeologous genomes such that recombination is suppressed among homeologous genomes within the polyploid derivative line. The elected claims also relate to the special case of stabilization in which control of apomixis is exercised to produce an obligate apomict in which recombination is completely suppressed. In such cases, homeology is not required to achieve genetic stabilization, because sexual seed formation, with its inherent risk of segregation back to sexuality, is no longer an

issue. Plant breeding is a well known technology, and techniques used in the art of plant breeding, such as bagging or emasculation of female parents, pollination, identification and selection of apomictic hybrids, chromosome doubling, B_{III} hybridization, and the like, are routine and have been used for many years.

Prior to the pioneering discoveries of the inventor described in the present application and in co-pending U.S. Patent Application No. 09/576,623 for Methods for Producing Apomictic Plants, it was not known in the art how to select sexual parent plants and hybridize them such that apomictic progeny could be selected. An extension or improvement of such methods for producing apomictic plants is the presently claimed invention relating to methods for stabilizing and controlling apomixis. Once the inventor understood the genetic processes that lead to expression of apomixis, it was then possible for the inventor to devise methods for stabilizing and controlling apomixis using well known, traditional plant breeding methods.

Therefore, th factor of the nature of the invention weighs in favor of the present disclosure being an enabling disclosure.

C. State of the Prior Art

Conventional wisdom prior to the filing of the instant specification held that apomixis is caused by an apomixis gene (or two) that is simply inherited. This conventional paradigm is

clearly challenged in co-pending U.S. Patent Application No. 09/576,623 and the present application.

The state of the prior art is to attempt to transfer the supposed one or two apomixis genes into sexual plant lines by breeding such lines with apomictic wild relative plants, which are usually used as the pollen (or sperm) donors because eggs of an apomict usually originate asexually and produce asexual (clonal) seed, i.e. without union of egg and sperm nuclei. The present application repudiates the apomixis gene theory and is based on asynchronous expression of many duplicate genes required for female or seed development. Plant breeding is well known in the art. Any skilled plant breeder would be able to stabilize apomixis in a plant line exhibiting genetic instability for apomixis by following the guidelines set out in the present application.

Therefore, this factor of the state of the prior art weighs in favor of the present application containing an enabling disclosure.

D. Level of One of Ordinary Skill in the Art

The level of skill of a person of ordinary skill in the art is relatively high. A person of ordinary skill in the art as of the filing date of the invention would know how to select plants for a plant breeding experiment and hybridize the selected plant lines by plant breeding. Such person would know how to recover seed from the hybridization, sow such seed, raise plants from such seed, and

select hybrid lines from among the progeny. Such person would know how to recognize apomixis in plants and how to determine whether the apomixis trait is unstable (as defined in the present disclosure) or not. Such person would know how to make polyploid derivative lines by chromosome doubling and B_{III} hybridization.

Thus, this factor of the level of one of ordinary skill in the art weighs in favor of the present disclosure being an enabling disclosure.

E. Level of Predictability of the Art

The amount of guidance or direction needed to enable the invention is inversely related to the amount of knowledge in the state of the art, as well as the predictability of the art. *In re Fisher*, 427 F.2d 833, 839, 166 USPQ 18, 24 (CCPA 1970). In other words, the more that is known in the prior art about the nature of the invention, how to make, and how to use the invention, and the more predictable the art is, the less information needs to be explicitly stated in the specification. In contrast, if little is known in the prior art about the nature of the invention and the art is unpredictable, the specification would need more detail as to how to make and use the invention to be enabling. MPEP § 2164.03. Further,

> [t]he "predictability or lack thereof" in the art refers to the ability of one skilled in the art to extrapolate the disclosed or known results to the claimed invention. If one skilled in the art can readily anticipate the

> effect of a change within the subject matter to which the claimed invention pertains, then there is predictability in the art. On the other hand, if one skilled in the art cannot readily anticipate the effect of a change within the subject matter to which that claimed invention pertains, then there is lack of predictability in the art. . . . The scope of the required enablement varies inversely with the degree of predictability involved, but even in unpredictable arts, a disclosure of every operable species is not required.

MPEP § 2164.03.

The Examiner alleged that this art is so unpredictable that an enabling disclosure has not been provided for the presently claimed invention. Applicant will now discuss the references cited by the Examiner.

S. Ellerström, 87 Hereditas 107-120 (1977) (hereinafter, "Ellerström (1977)"), reported a high level of sterility in amphidiploid hybrid *Raphanobrassica* from crosses between fodder radish and marrow-stem kale. On average, only 0.2 hybrid seeds were obtained per pollinated flower. Seed set in the first generation hybrids was only 0.1 seeds per pollinated flower. However, repeated selection during 6 generations improved seed fertility to 2.3 seeds per pollinated flower. Ellerström (1977) treated the subject of sterility and improving seed set through selection over 6 generations, but failed to disclose anything about the average frequency of apomixis from generation to generation.

The objective of the study reported by Hovin et al., 16 Crop Sci. 635-638 (1976) (hereinafter, "Hovin"), was to determine if the quality of seed produced by 41 different lines (introductions,

cultivars, and experimental strains) of the naturally apomictic Kentucky bluegrass was affected by location of seed production (specific locations within seven states, which represented different latitudes, or natural photoperiod regimes, and different environmental conditions). Hovin concluded that (1) the quality of seed produced from naturally apomictic lines of Kentucky bluegrass is higher (fewer weak or aberrant seedlings) when seed is produced at higher latitudes, and (2) the origin of the lines tested was not important to the former conclusion. This information is relevant to the processes of producing apomictic plants from sexual plants in terms of reciting standard methodologies known in the art for inducing flowering. In other words, conditions can be modified experimentally to induce flowering in introductions, cultivars, and experimental strains that would otherwise be difficult to work with. Likewise, the Purnhauser et al., 21 Cereal Res. Comm. 175-179 (1993) (hereinafter, "Purnhauser"), paper provides interesting methodology for facilitating the crossing of plants that do not flower at the same time (different sexual wheat lines). In other words, Purnhauser shows that techniques are well known in the art that permit crossing of non-synchronously flowering plants.

Bates, Proceedings of World-wide maize improvement in the 70's and the role of CIMMYT (1974) (hereinafter, "Bates") and Garcia et al., 74 Maize Genet. Coop. Newsletter 40-41 (2000) (hereinafter, "Garcia"), teach difficulties in and solutions for accomplishing

interspecific and intergeneric hybridizations in plants. It is widely recognized that difficulties in achieving wide hybridization usually increase with the divergence of the cross, and specialized techniques, such as embryo rescue, the use of specific genotypes, and the pollination of large numbers of pistils, are often used (J. Torabinejad, J.G. Carman, C.F. Crane, 29 Genome 150-155 (1987); Z.-W. Liu, R.R.-C. Wang, J.G. Carman, 89 Theor. Appl. Genet. 599-605(1994)). However, wide hybridization is not a necessary component for practicing the methods of the instant application. What is claimed is that the same methodology used to produce apomictic plants from sexual plants within species can be used among species regardless of the understood additional numbers of pollinations and other procedures that may be required to achieve interspecific hybridization.

An objective of the DeWet et al., 23 Caryologia 183-187 (1970) (hereinafter, "DeWet") study was to determine if the apomixis trait could be readily transferred from *Tripsacum* to corn (*Zea mays*) by hybridization. DeWet teaches the crossing of sexual *Zea mays* (2n = 2x) as female with apomictic *Tripsacum dactyloides* (2n = 4x) as male. DeWet teaches the recovery of sexual triploid progeny that tend to be genetically stable when backcrossed to maize. This occurred because of an unusual elimination of maize chromosomes during megasporogenesis in the intergeneric triploid hybrid, the unusual retention of a diploid complement of *Tripsacum*

chromosomes during megasporogenesis, and the restoration of a haploid complement of maize chromosomes upon fertilization by maize sperm to restore the triploid number. In DeWet the occasional genetic instability noted in this system was caused by sexual meiosis, not apomeiotic processes. DeWet explored the transfer of apomixis genes from an apomictic wild plant to a related sexual crop through introgression (hybridization and backcrossing).

A variety of methods have been developed for clearly differentiating sexually-derived progeny of a facultative apomict (a plant that produces seed both sexually and apomictically) from apomictically-derived progeny from the same facultative apomict. The most reliable methods involve dominant morphological or codominant molecular markers, and powerful molecular procedures, e.g. SSRs, RAPDs, etc., are now being used for this purpose (O. Leblanc & A. Mazzucato, Screening procedures to identify and quantify apomixis, in *The Flowering of Apomixis: From Mechanisms to Genetic Engineering*, Mexico, D.F.: CIMMYT, IRD, European Commission DG VI, FAIR (Y. Savidan, J.G. Carman, T. Dresselhaus eds 2001). The Examiner cites several authors (Hovin; Garcia; deWet; Hanna et al., 27 Crop Sci. 1136-1139 (1987) (hereinafter, "Hanna"); Holm et al., 125 Hereditas 77-82 (1996) (hereinafter, "Holm")), from which he concludes that in the absence of reliable histological, chromosome counting, karyotyping, and progeny test marker techniques, the screening of apomictic plants for percentage

apomictic progeny (versus sexual progeny) is unpredictable. Applicant has no argument with this, however, in the same breath it must be recognized that such techniques are well known in the art. The process of selecting apomictic progeny from a hybridization of parent plants encompasses these techniques. .

Hovin discloses histological procedures to observe and describe the development of both sexual and aposporous embryo sacs in apomictic Kentucky bluegrass accessions. In aposporous species, it is normal for a sexual embryo sac and one or more aposporous embryo sacs to initiate formation at about the same time within the same ovule. Generally, in such ovules, sexual embryo sac formation aborts (sometimes the meiocyte aborts prior to the embryo sac stage), the aposporous embryo sac(s) then absorbs the remains of the degenerating sexual meiocyte or embryo sac, and the aposporous embryo sac matures and becomes functional. Hovin concluded that histological analyses for verifying aposporous embryo sac formation in Kentucky bluegrass are only reliable when pistils are examined at early stages, e.g. the megasporogenesis to early (1 to 2 nucleate) embryo sac stage of seed development. This is a common condition of accurate embryological assessments of apomictic expression, and it is exactly how Applicant documents aposporous embryo sac formation in the *Sorghum* lines Applicant has developed that produce aposporous embryo sacs (Declaration of John G. Carman under 37 C.F.R. § 1.132). In older Kentucky bluegrass pistils,

Hovin noted that it is impossible to determine if a maturing embryo sac is of sexual or apomictic origin. Again, this is a common and well documented limitation of histological methods for determining if plants are reproducing sexually or apomictically. In practice, if a pistil is too old or too young, it is discarded and a younger or older pistil is analyzed. The current convention is to analyze pistils that are in the late megasporogenesis (functional megaspore stage) to two nucleate embryo sac stage for apospory and in the early megasporogenesis (meiotic dyad stage) to the one nucleate embryo sac stage for diplospory. At these stages, reliable estimates of percentage apomictic embryo sac formation compared to percentage sexual embryo sac formation can usually be obtained. Such procedures for obtaining accurate estimates are commonly understood by those currently working in the field (e.g., S.E. Asker & L. Jerling, Apomixis in plants (CRC Press, Boca Raton, Fla. 1992); Y. Savidan, J.G. Carman, T. Dresselhaus, *The Flowering of Apomixis: From Mechanisms to Genetic Engineering*, Mexico, D.F.: CIMMYT, IRD, European Commission DG VI, FAIR (2001)).

As noted by Ellerström (1977), Ellerström (1983), Hovin, Garcia, deWet, Hanna, and Holm, the determination of whether a plant is producing seed apomictically or sexually is best accomplished through a combination of embryological (histological) analyses and progeny tests, and reliable procedures for both are available (reviewed by O. Leblanc & A. Mazzucato, Screening

procedures to identify and quantify apomixis, in *The Flowering of Apomixis: From Mechanisms to Genetic Engineering*, Mexico, D.F.: CIMMYT, IRD, European Commission DG VI, FAIR (Y. Savidan, J.G. Carman, T. Dresselhaus eds 2001). The references cited in the Office Action discuss ways to determine if progeny of a plant are produced apomictically or sexually. Such determinations are secondary to practicing the methods of the instant specification. What is claimed is a method for stabilizing apomixis in plants unstable for the apomixis trait by producing polyploids using chromosome doubling or B_{III} hybridization, both of which are well known methods in the art, such that duplicate genes responsible for apomixis are isolated from each other on opposite homeologous genomes such that recombination is suppressed among homeologous genomes within the polyploid line (claim 1).

Ellerström (1983) reported obtaining 969 sexually produced seeds from the putative yellow-flowering line of his experiment. Further, Ellerström reported obtaining one apomictically derived progeny plant from 975 plants derived from the putative apomictic line. However, Ellerström failed to report observing the average frequency of sexual seed formation of any of the 969 sexually produced progeny of the one putative apomictic line. Moreover, Ellerström failed to report a comparison of the average frequency of sexual seed formation among sexually produced progeny of the putative apomictic line as either exceeding, remaining the same as,

or being less than the average frequency of sexual seed formation of the putative apomictic line. Therefore, Ellerström failed to observed genetic stability or instability of the putative apomictic plant. Since Ellerström failed to observe genetic stability or instability, he also failed to report stabilizing genetic instability.

Kraft et al., 101 Theor. Appl. Genet. 323-326 (2000) (hereinafter, "Kraft"), J.G. Carman, 61 Biol. J. Linn. Soc. 51-94 (1997) (hereinafter, "Carman-Linnean"); and Bashaw et al., Apomictic Grasses, in 2 Principles of Cultivar Development - Crop Species 40-82 (MacMillan 1987) (hereinafter, "Bashaw"), are cited as indicating that the number of genes and genetic modifiers important to the expression of apomixis is unknown but may include one to a few genes with major effects and several or more modifiers with minor effects.

Those who reject the idea of multiple genes being involved (who believe apomixis is simply inherited via an apomixis gene) have claimed that a partial or step-wise accumulation of the essential alleles at multiple loci in a plant through natural evolutionary processes or through plant breeding would tend to be deleterious to plant fertility, which would further complicate (a) the evolution of apomictic plants in nature (making it unlikely in their opinion that apomixis evolved in this manner) or (b) the production of apomictic plants from sexual plants in a breeding

program. For example, the accumulation of alleles that would cause a failure of meiosis without unreduced embryo sac formation occurring would cause sterility. Likewise, the accumulation of alleles that cause unreduced embryo sac formation without a simultaneous accumulation of alleles that cause parthenogenesis would cause a fatally excessive degree of polyploidy. Hence, it is argued that apomixis could not have evolved by "evolutionary steps" involving the gradual accumulation of unique mutations (or unique alleles) the sum of which encode apomixis because too many intermediate stages, between sexual fertility and apomixis fertility, are sterile. Hence, those arguing that apomixis is simply inherited argue that one to a very few mutation(s) that confer apomixis (the apomixis gene hypothesis) is the most likely explanation for the evolution of apomixis (see S.E. Asker & L. Jerling, *Apomixis in Plants* (CRC Press, Boca Raton, FL 1992); M. Mogie, *The Evolution of Asexual Reproduction in Plants* (Chapman and Hall, London 1992); Y. Savidan, J.G. Carman & T. Dresselhaus, *The Flowering of Apomixis: From Mechanisms to Genetic Engineering* , Mexico, D.F.: CIMMYT, IRD, European Commission DG VI, FAIR 2001).

The inventor discovered, and disclosed in both the co-pending U.S. Patent Application No. 09/576,623 and the present application, that the seemingly complex situation in which many genes are required for the expression of apomixis is not as evolutionarily unlikely as taught in the conventional literature (discussed

above). In contrast, the production of apomictic plants by man can be predictable because the Applicant discovered that apomixis evolved in nature through hybridization of highly fertile sexual plants, which differ from each other in timing of megasporogenesis, embryo sac formation, and other female development stages. The inventor's pioneering discoveries included the following: (1) the important genes and modifiers required to express apomixis are not "apomixis genes" per se but are genes (with multiple alleles in natural populations) that encode normal floral induction processes and normal sexual seed development processes, (2) within angiospermous species, genera, or families, the normal floral and seed development processes involved in the evolution of apomixis are highly variable among ecotypes, in terms of ontogenetic timing (due to variously adaptive among-ecotype polyallelism), but tend to be invariable within ecotypes (due to natural selection within ecotypes), (3) the ecotypically unique ontogenetic types of expression of normal floral and seed development processes represent readily distinguishable ontogenetic phenotypes that are readily quantifiable by commercial pace embryology analysis processes, (4) apomixis evolves in nature somewhat instantaneously (generally one to three B_{II} and/or B_{III} hybridization steps, instead of numerous steps in which alleles accumulate gradually and intermediates are sterile) through inter-ecotypic (secondary-contact) hybridizations among divergent ecotypes that express

normal but specifically divergent floral and sexual seed development processes, and (5) the evolutionary steps responsible for apomixis arising in nature can be mimicked and accelerated by man in commercial-pace plant breeding programs designed to produce apomictic plants from sexual plants. By understanding the phenotypes of the major genes and modifiers responsible for apomixis, it is possible to identify pairs of divergent sexual plants that produce apomictic plants when hybridized.

Once a person skilled in the art recognizes how the duplicate gene asynchrony theory explains how apomixis arises, it is a straightforward matter to see how plant breeding steps can be used to stabilize apomixis in apomictic lines exhibiting instability for this trait.

Therefore, the predictability of this invention is much greater than has been recognized by the Examiner. It requires routine procedures for a person skilled in the art of plant breeding to produce a genetically stable allopolyploid apomictic hybrid from a genetically unstable interspecific apomictic diploid hybrid or to confer sexual sterility in a genetically unstable apomict by conferring sexual sterility, through odd polyploidy or through meiotic mutants, while keeping apomictic fertility intact.

F. Amount of Direction Provided by the Inventor

The application contains a thorough explanation of how the present duplicate-gene asynchrony approach to making apomictic plants is consistent with the observations that have been made in the apomixis field over many years and further explains why the theories and assumptions of the prior art are deficient. Once it is understood by a person skilled in the art of plant breeding how apomixis arises, it is a routine matter to (a) produce polyploids by chromosome doubling or B_{III} hybridization such that the duplicate genes responsible for apomixis are recombinationally isolated from each other by allopolyploidy, i.e. by isolating them on opposite homeologous chromosomes such that recombination, and hence segregation resulting in sexuality, is inhibited or (b) to confer sexual sterility in a genetically unstable apomict as discussed above.

G. Working Examples

Compliance with the enablement requirement of 35 U.S.C. § 112, first paragraph, does not turn on whether a working example is disclosed. MPEP § 2164.02. The presence or absence of working examples, however, is a factor to be considered. Nevertheless, a working example of producing a genetically stable apomict from a facultatively apomictic line, *Tripsacum* hybrid (*T. laxum* x *T.*

pilosum amphiploid), has been provided in the current specification, page 33, lines 1-7. In this example, a tetraploid facultative apomict (approx. 50% diplosporous embryo sac formation) was converted to a near obligate genetically-stabilized apomict by producing a triploid (odd ploidy level) derivative line. The triploid derivative was apomictically fertile (80% apomictic embryo sacs) but sexually sterile (20% abortive sexual meioses or sexual embryo sacs). Since this plant fails to produce seed sexually (sexual seed abortion conferred through odd ploidy), it is genetically stable. Page 8, lines 3-7; page 10, line 34, to page 11, line 1.

H. Quantity of Experimentation

Some experimentation will likely be necessary with each new species or genus of plant used in making apomictic hybrids. However, based on the guidance provided in the specification, such experimentation would be merely routine.

Based on all of these factors, the great preponderance of the evidence weighs in favor of an enabling disclosure having been provided. For these reasons, it is respectfully submitted that the requirements of an enabling disclosure under 35 U.S.C. § 112, first paragraph, have been met. Thus, withdrawal of the rejection on this ground is respectfully requested.

VII. Rejection under 35 U.S.C. § 102

Before discussing rejections based upon 35 U.S.C. § 102, it is proper to state that to sustain a rejection under § 102 the Patent and Trademark Office must abide by the following statement of the law.

> Under 35 U.S.C. § 102, anticipation requires that each and every element of the claimed invention be disclosed in a prior art reference. *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 1554, 220 USPQ 303, 313 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984). In addition, the prior art reference must be enabling, thus placing the allegedly disclosed matter in the possession of the public. *In re Brown*, 329 F.2d 1006, 1011, 141 USPQ 245, 249 (CCPA 1964).

Akzo N.V. v. U.S. Int'l Trade Comm'n, 1 U.S.P.Q.2d 1241, 1245 (Fed. Cir. 1986).

The Examiner rejected claims 1-2, 5, 8-9, and 12 under 35 U.S.C. § 102(e) as allegedly being anticipated by U.S. Patent No. 5,811,636 (hereinafter, "Hanna '636).

Claim 1 is drawn to a method for genetically stabilizing an apomictic plant exhibiting genetic instability comprising producing a polyploid derivative line through chromosome doubling or B_{II}: hybridization such that duplicate genes responsible for apomixis are isolated from each other on opposite homeologous genomes such that recombination is suppressed among homeologous genomes within the polyploid derivative line.

Claim 2 is drawn to a method for stabilizing an apomictic plant exhibiting genetic instability comprising producing a

polyploid derivative line through chromosome doubling or B_{III} hybridization such that duplicate genes responsible for apomixis are isolated from each other by segmental allopolyploidy, and increasing fertility of the apomictic segmental allopolyploid by selfing or hybridizing with a similar plant to obtain sexually derived progeny that express greater pollen fertility, unreduced egg fertility, or parthenogenesis.

Claim 5 is drawn to a method for genetically improving plants comprising (a) producing an apomictic plant, determining if the apomictic plant is genetically stable, and if it is not stable, then genetically stabilizing it to result in a genetically stabilized derivative line; (b) genetically enhancing the apomictic plant or genetically stabilized derivative line through plant breeding procedures; and (c) breeding the genetically stabilized derivative line or genetically enhanced derivative line such that female meiosis aborts, causing a special case of genetic stabilization particularly adapted to intraspecific hybrids, or facultative apomixis occurs (exceptions are noted in the claim).

Claims 8, 9, and 12 are product-by-process claims related to claims 1, 2, and 5, respectively.

It is a well settled point of patent law that "a patentee is free to be his own lexicographer." *Markman v. Westview Instruments, Inc.*, 34 USPQ2d 1321, 1330 (Fed. Cir. 1995) (in banc), *aff'd*, 517 U.S. 370, 38 USPQ2d 1461 (1996). This principle is

subject to two limitations: first, that the meaning must be made clear in the specification, *Id.*, and, second, any special meaning must be consistently adhered to in determining patentability and validity, as well as infringement, *W.L. Gore & Assocs. Inc. v. Garlock Inc.*, 6 USPQ2d 1277, 1280 (Fed. Cir. 1988). "Genetic instability" is a term defined at page 12, lines 7-9, of the application: "[G]enetic instability of an apomictic plant means the average frequency of sexual seed formation among sexually produced progeny of such plant exceeds that of such apomictic plant." See also page 1, lines 5-11. In other words, in a genetically unstable apomictic plant the average frequency of sexual seed formation increases from one generation to the next in sexually produced progeny. "Stabilizing" a facultatively apomictic plant means "assuring that the average frequency of sexual seed formation among sexually derived progeny of such plant does not exceed that of such apomictic plant." Page 12, lines 10-13. In other words, in a genetically stable apomictic plant the average frequency of sexual seed formation stays essentially the same from one generation to the next in sexually produced progeny.

Hannah '636 discloses at column 4 line 45 through column 5 line 33 that interspecific hybrids of sexual pearl millet with wild relatives are generally highly male sterile, but progress in trying to introgress apomixis genes into pearl millet requires some normal male meiosis. This is achieved by elevating male fertility in

complex hybrids produced between induced tetraploid pearl millet, the wild apomictic species *Pennisetum squamulatum*, and a third species, *P. purpureum*. Hannah '636 fails to disclose stabilizing genetic instability in apomictic plants, i.e., maintaining the same average frequency of sexual seed formation from one generation to the next in sexually produced progeny of the apomictic plants. In fact, Hannah '636 fails to disclose that the apomictic plant is genetically unstable, much less stabilizing such apomictic plant. Instead, Hannah '636 discloses increasing the male fertility of hybrids between sexual pearl millet and an apomictic wild relative. Therefore, Hannah '636 fails to disclose each and every element of the claimed invention, and thus fails to anticipate the presently claimed invention.

Hannah '636 fails to disclose any method for genetically stabilizing an apomictic plant exhibiting genetic instability, as the terms "stabilizing" and "genetic instability" are used in the present application. Hannah '636 treats the subject of male fertility, but fails to disclose anything about the average frequency of apomixis from generation to generation. Therefore, Hannah '636 fails to disclose each and every element of the presently claimed invention, and thus fails to anticipate the claims at issue.

Claims 1-2 and 8-9 were rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by Ellerström (1977).

S. Ellerström, 87 Hereditas 107-120 (1977) (hereinafter, "Ellerström (1977)"), reported a high level of sterility in amphidiploid hybrid *Raphanobrassica* from crosses between fodder radish and marrow-stem kale. On average, only 0.2 hybrid seeds were obtained per pollinated flower. Seed set in the first generation hybrids was only 0.1 seeds per pollinated flower. However, repeated selection during 6 generations improved seed fertility to 2.3 seeds per pollinated flower.

Ellerström (1977) failed to disclose any method for genetically stabilizing an apomictic plant exhibiting genetic instability, as the terms "stabilizing" and "genetic instability" are used in the present application. Ellerström (1977) treats the subject of sterility and improving seed set through selection over 6 generations, but fails to disclose anything about the average frequency of apomixis from generation to generation. Therefore, Ellerström (1977) fails to disclose each and every element of the presently claimed invention, and thus fails to anticipate the claims at issue.

Claims 5 and 12 were rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by S. Saran et al., 11 J. Cytol. Genet. 22-28 (1976) (hereinafter, "Saran").

Saran describes the effects of different photoperiods on facultativeness of a facultatively apomictic tetraploid *Dichanthium intermedium* hybrid whose parents were also members of the

facultatively-apomictic species *D. intermedium* (page 22, first sentence, Materials and Methods). The last sentence of the introduction (page 22) implicitly states what the paper deals with, i.e. "the effect of photoperiod on the mode of reproduction in the facultatively apomictic compilospecies, *Dichanthium intermedium*." More succinctly, Saran describes apomictic hybrids produced from apomictic parents. Neither this paper nor subsequent review articles and books on apomixis that review this paper (e.g., S.E. Asker & L. Jerling, Apomixis in Plants 90 (CRC Press 1992); M. Mogie, *The Evolution of Asexual Reproduction in Plants* 150 (Chapman and Hall, London 1992), disclose or suggest that Saran produced (or claimed to have produced) an apomictic *Dichanthium* by hybridizing two sexual *Dichanthium* genotypes (absence of facultative expression of apomixis).

Saran fails to disclose producing an apomictic plant and stabilizing the apomictic plant, if unstable, by any method. For the reason that Saran fails to disclose each and every element of the presently claimed invention, withdrawal of the rejection of claims 5 and 12 under 35 U.S.C. § 102(b) is respectfully requested.

Claims 8-9 and 12 were rejected under 35 U.S.C. § 102(e) as allegedly being anticipated by U.S. Patent No. 5,710,367 (hereinafter, "Kindiger"). Alternatively, these claims were rejected under 35 U.S.C. § 103(a) as allegedly being obvious over Kindiger. The rejection under section 102(e) will be dealt with in

this section, while the rejection under section 103 will be dealt with in the section that follows.

Kindiger discloses apomictic maize/*Tripsacum* hybrids having a ratio of maize to *Tripsacum* chromosomes of at least 30:9. At column 6, Kindiger discusses a model for inheritance of apomixis and expected maternal fertility. Kindiger fails to disclose instability of apomixis as the terms "stability" and "instability" are used in the present application, and further fails to disclose any method for stabilizing apomixis from generation to generation in apomictic lines exhibiting instability for the apomixis trait.

Kindiger, therefore, fails to disclose each and every element of the presently claimed invention. Thus, Kindiger fails to anticipate the claims at issue. For these reasons, withdrawal of the rejection of claims 8, 9, and 12 under 35 U.S.C. § 102(e) over Kindiger is respectfully requested.

In view of the above, none of the claims presently under consideration is anticipated by any of the cited references. Withdrawal of all rejections under Section 102 is respectfully requested.

VII. <u>Rejection Under 35 U.S.C. § 103</u>

Before responding directly to the issues raised by the Examiner under Section 103, the legal foundation for sustaining

such a rejection will be reviewed. Briefly, the burden is first on the Patent Office to establish a *prima facie* case of obviousness. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). If no *prima facie* case of obviousness is established, then a rejection under Section 103 cannot properly be sustained. *In re Oetiker*, 24 U.S.P.Q.2d 1443 (Fed. Cir. 1992). If the Patent Office establishes a *prima facie* case of obviousness, then the burden of production shifts to the applicant to provide appropriate rebuttal, but the burden of persuasion always remains with the Patent Office. *Id.* Such rebuttal may include arguments, amendments, and/or presentation of objective indicia of nonobviousness. Evidence of these objective indicia are always relevant to a determination of nonobviousness whether or not a *prima facie* case of obviousness has been established. *Stratoflex Inc. v. Aeroquip Corp.*, 218 U.S.P.Q. 871, 879 (Fed. Cir. 1987). To establish a *prima facie* case of obviousness, the Examiner must show all of the limitations of the claimed invention in the prior art. *In re Ehrreich*, 200 U.S.P.Q. 504, 509-11 (C.C.P.A. 1979). The subject matter of the invention must be considered as a whole and through the eyes of a hypothetical person of ordinary skill, not expert skill, in the relevant art at the time the invention was made. *Connell v. Sears, Roebuck & Co.*, 220 U.S.P.Q. 193, 199 (Fed. Cir. 1983). References must also be considered as a whole, including subject matter that teaches away from the invention as well as subject matter that

suggests the invention, and not for their isolated teachings. *Ashland Oil, Inc. v. Delta Resins & Refractories, Inc.*, 227 U.S.P.Q. 657, 669 (Fed. Cir. 1985). References may be combined if there is a suggestion, motivation, or incentive in the prior art to make such a combination. *In re Dillon*, 16 U.S.P.Q.2d 1897, 1901 (Fed. Cir. 1990) (en banc); *In re Jones*, 21 U.S.P.Q.2d 1941, 1943-44 (Fed. Cir. 1992). It is not permissible to use hindsight to pick and choose among isolated teachings in the art after first having read Applicant's application to learn the pattern of the invention. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596, 1600 (Fed. Cir. 1988).

Pursuant to established legal authority, patentability under 35 U.S.C. § 103 requires a four-step analysis, which involves determining (1) the scope and content of the prior art, (2) the differences between the prior art and the claimed inventions, (3) the level of skill in the art, and (4) the objective evidence of nonobviousness that may have been presented. *W.L. Gore & Assocs., Inc. v. Garlock, Inc.*, 220 U.S.P.Q. 303, 311, 314 (Fed. Cir. 1983). After all of these factors have been considered, the ultimate legal conclusion on the issue of obviousness must be reached. With the above background in mind the rejections under 35 U.S.C. § 103 will be discussed.

Claims 8-9 and 12 were rejected under 35 U.S.C. § 103(a) as allegedly being obvious over Kindiger. The teachings of Kindiger

were briefly reviewed in the preceding section relating to Section 102. Kindiger fails to disclose instability of apomixis as the terms "stability" and "instability" are used in the present application, and further fails to disclose or suggest any method for stabilizing apomixis from generation to generation in apomictic lines exhibiting instability for the apomixis trait.

Kindiger, therefore, fails to show all the limitations of the presently claimed invention in the prior art. Thus, Kindiger fails to render the presently claimed invention obvious to a person of ordinary skill in the art at the time the invention was made. For this reason, a *prima facie* case of obviousness has not been established. Withdrawal of this ground of rejection is thus respectfully requested.

Claims 1-2, 5, 8-9, and 12 were rejected under 35 U.S.C. § 103(a) as allegedly being obvious over Ellerström (1977) in view of Ellerström (1983). Both Ellerström (1977) and Ellerström (1983) were discussed above. Neither Ellerström (1977) nor Ellerström (1983), alone or in combination, discloses or suggests genetic instability of the apomixis trait, much less a method of stabilizing such genetic instability. Therefore, the combination of Ellerström (1977) and Ellerström (1983) fails to show all the limitations of the presently claimed invention. Hence, a *prima facie* case of obviousness has not been established. Accordingly, withdrawal of this ground of rejection is respectfully requested.

Claims 5 and 12 were rejected under 35 U.S.C. § 103(a) as allegedly being obvious over Saran in view of Bashaw et al., Apomictic Grasses, in 2 Principles of Cultivar Development 40-82 (Fehr ed. 1987) (hereinafter, "Bashaw").

The teachings of Saran were reviewed above. Briefly, Saran discloses production of apomictic plants from apomictic parents. Saran further discloses the effects of different photoperiods on facultativeness of a facultatively apomictic tetraploid *Dichanthium intermedium* hybrid. Saran fails to disclose or suggest genetic instability of the apomixis trait from generation to generation and further fails to disclose or suggest a method of stabilizing such genetic instability.

Bashaw discloses that results of genetic investigations of hybrids between sexual and apomictic plants indicate simple inheritance of apomixis. Bashaw at 45. Bashaw fails to disclose or suggest a method for stabilizing genetic instability of the apomixis trait.

The combination of Saran and Bashaw fails to disclose or suggest a method for genetically stabilizing genetic instability of apomixis. For this reason, a *prima facie* case of obviousness has not been established with respect to the claims at issue. Therefore, withdrawal of the rejection of claims 5 and 12 under 35 U.S.C. § 103(a) is respectfully requested.

It is respectfully submitted that no *prima facie* case of obviousness has been established concerning any claim presently under consideration. Therefor, withdrawal of these grounds of rejection under 35 U.S.C. § 103 is respectfully requested.

VIII. Conclusion

Should the Examiner deem it advisable to conduct a telephone interview for any reason, the undersigned attorney would be most agreeable to receiving a collect telephone call to expedite the prosecution of the application.

For the reasons given above, Applicant respectfully requests reconsideration and allowance of Claims 1, 2, 5, 8, 9, and 12 and passage of this application to issue.

DATED this 15th day of November, 2002.

Respectfully submitted,

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Version with Markings to Show Changes Made

IN THE ABSTRACT:

Please amend the Abstract of the Disclosure such that is reads as follows:

[The present invention relates to the induction, stabilization, and control of apomixis (asexual seed formation) in angiosperms for the purpose of producing, improving, and economically using superior-yielding agamic crops (crops possessing a capacity for both sexual and apomictic seed production). "Stabilizing" apomixis refers to processes that either convert a facultative apomict to obligate apomixis or confer mechanisms to a facultative apomict that prevent, during facultative sexual seed formation, the recombination of genes that cause apomixis such that progeny produced sexually from said facultative apomict inherit the allelic combinations required for apomixis. More specifically the present invention relates to (i) the production of two or more sets of genetically divergent sexual lines, either inbred or outcrossed, which sets of parental lines remain homozygous for genes that cause apomixis when hybrids are produced by crossing a member of one or such sets of lines with a member from another set, (ii) the hybridization of sexual inbred or outcrossed parental lines to produce apomicts, (iii) the stabilization of such apomicts through cytogenetic or molecular modifications, (iv) the improvement of apomicts by breeding or genetically engineering parental lines or

apomicts, (v) the modification of facultative apomicts to abort female meiosis resulting in obligate apomixis except when a recombinant DNA that aborts meiosis is inhibited, and (vi) the modification of facultative apomicts to remain facultative except during inducible expression of a recombinant DNA that causes obligate apomixis by aborting meiosis. The various facets of this biological operating system may be selectively combined for the efficient production, improvement, and use of agamic crops.]

Methods are disclosed for detecting genetic instability for apomixis in angiospermous plant, and for enhancing, genetically stabilizing, and controlling apomixis expression in such plants. Enhanced expression, stabilization, and control are achieved by converting a facultative apomict to obligate apomixis. Enhanced expression of apomixis is further achieved by increasing frequencies of unreduced egg formation and/or parthenogenesis. Genetic stabilization of apomixis is alternatively achieved by conferring mechanisms to a facultative apomict that, during facultative sexual seed formation, prevent the segregational loss of unique alleles at multiple loci, which cause apomixis, such that progeny produced sexually from the facultative apomict inherit the unique allelic combinations required to maintain apomixis. The disclosed methods are used in various combinations to produce apomictic plants that possess improved yield, quality, and/or seed production characteristics.